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June 2, 2006

Mail Stop Certificate of Corrections Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450



Re: U.S. Patent No.: 7,012,940 B2
Issued: March 14, 2006
Inventor: Yusuke Tamaki et al.
Our Docket: 35861

Sir:

A Certificate of Correction under 35 U.S.C. 254 is hereby requested to correct Patent Office printing errors in the above-identified patent. Enclosed herewith is a proposed Certificate of Correction (Form No. PTO-1050) for consideration along with appropriate documentation supporting the request for correction.

It is requested that the Certificate of Correction be completed and mailed at an early date to the undersigned attorney of record. The proposed corrections are obvious ones and do not in any way change the sense of the application.

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date indicated below.

| Jeffrey J. Sopko | | June 2, 2006 |
|---|---|---|
| Name of Attorney for Applicant(s) | Signature of Attorney | Date |

We understand that a check is not required since the errors were on the part of the Patent and Trademark Office in printing the patent.

Very truly yours,

Jeffrey J. Sopko, Reg. No. 27676

JJS:alw
Enclosures

JUN 8 2006

# UNITED STATES PATENT AND TRADEMARK OFFICE
## CERTIFICATE OF CORRECTION

PATENT NO. : 7,012,940 B2 PAGE 1 OF 1

DATED : March 14, 2006

INVENTOR(S) : Yusuke Tamaki et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 2, line 27, please delete "tensing", and insert therefor --lensing--.

Column 2, line 29, please delete "tensing", and insert therefor --lensing--.

Column 2, line 42, please delete "tensing", and insert therefor --lensing--.

Column 2, line 46, please delete "tensing", and insert therefor --lensing--.

Column 2, line 65, please delete "tensing", and insert therefor --lensing--.

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PATENT NO. 7,012,940 B2

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resonator. Fig. 4(a) shows the case where thermal lensing does not occur, and Fig. 4(b) shows the case where thermal lensing does occur.

In the state of Fig 4(a) without thermal lensing, the laser beam 106 and excitation laser beam 108 roughly overlap inside the laser medium 104, and the excitation energy provided to the laser medium 104 by the excitation laser beam 108 can be efficiently used for amplification of the laser beam 106.

However, when thermal lensing occurs, there is a deviation between the states of the two laser beams, and when the state of overlap between the lasers in the laser medium 104 becomes poor as shown in Fig. 4(b), the amplification efficiency of the laser 106 is reduced. In the state shown in Fig. 4(b), the spot diameter of the laser 106 increases, as a result of which the laser 106 passes through much of the area in the laser medium 104 which has not been excited, thus reducing the efficiency. Additionally, only the area centered around the spot of the laser beam 106 is amplified, which results in reduced beam quality of the laser beam being used. Conversely to the case of Fig. 4(b), if the spot diameter of the laser 106 becomes smaller, then the laser beam 106 will pass through only a portion of the area of the laser medium amplified by the excitation laser beam 108. Therefore, only a portion of the energy which is invested by the excitation laser beam can be used, and this leads to reduced efficiency. Additionally, if the spot diameter of a laser is reduced in this way, the energy density increases and leads to damage in the laser medium.

While the effects of thermal lensing have been described here by taking as an example the spot diameter which is visually easy to grasp, the thermal lensing effect can also affect the modes of the laser beams inside the laser medium, thus also reducing the mode-matching between the laser beam and the excitation laser beam.

This also leads to reduced efficiency and reduced beam quality.

This thermal lensing effect can be overcome by adequately cooling the laser medium, as long as the laser has a low output power. Additionally, in apparatus in which thermal lensing occurs, the state of the thermal lens remains mostly stable after reaching the steady state during operation, so that the shapes and positions of mirrors 109, 110 can be designed to optimally compensate for this state.

However, if the laser power is made higher, the thermal lensing effect in the laser medium will change during operation of the laser device or over repeated activity and suspension of the laser device, making it difficult to preemptively compensate for this effect in the design of the laser resonator. Specifically, the thermal lensing effect will vary with changes in the output power of the excitation laser beam, changes in the state of oscillation of the laser, and variations in the heat removing devices. If the state of the thermal lens in the laser medium changes considerably during the course of operation of the laser device, adjustments such as changes to the angles or movement of the positions of the mirrors 109, 110 must be made in order to compensate for this in conventional laser resonators. In order to do so, the operation of the laser device must be suspended, and time must be taken to perform work, thus making such compensation impractical.

## BRIEF SUMMARY OF THE INVENTION

The present invention was made in view of the above-described problems, and has the object of offering a laser resonator capable of maintaining a high amplification efficiency even when the thermal lensing effect varies during operation or over repeated operation and suspension, as well as a method for adjusting a laser